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TREATMENT RESEARCH AT THE U.S. ENVIRONMENTAL PROTECTION AGENCY IN SUPPORT OF THE RESOURCE CONSERVATION AND RECOVERY ACT LANDFILL BAN PROVISION

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This paper describes the role that EPA's Office of Research and Development is playing in supporting the Agency's deliberation with respect to the landfill ban provisions. Research programs that are currently being carried out are described in detail. Program plans for future years are also discussed.

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ABSTRACT

With the reauthorization of the Resource Conservation and Recovery Act (RCRA) of 1984, the U.S. Environmental Protection Agency (EPA) was required to ban the disposal of hazardous waste to the land. The Congressional mandate to ban was accompanied by a decision or "hammer" date for each waste type. By the "hammer" date, EPA must ban the targeted waste stream or determine that a temporary extension of the ban implementation date is warranted since insufficient alternative waste treatment capability exists. Therefore, EPA must have adequate knowledge of existing alternative (to land disposal) treatment technologies. The Agency must have data on the technical capabilities of alternative technologies, on the existing capacities of such technologies, and on the abilities of such technologies to accommodate targeted waste streams within the "hammer" dates.

This paper describes the role that EPA's Office of Research and Development is playing in supporting the Agency's deliberation with respect to the landfill ban provisions. Research programs that are currently being carried out are described in detail. Program plans for future years are also discussed.

INTRODUCTION

The 1984 amendments to the Resource Conservation and Recovery Act of 1976 (RCRA) require, among other items, the following:

- The land disposal of a hazardous waste must be banned unless EPA determines that the prohibition of one or more methods of land disposal is not required in order to protect human health and the environment.
- EPA must promulgate regulations specifying levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste such that threats to human health and the environment are minimized.
- EPA must decide whether to ban the land disposal of the following wastes within the following time frame from enactment (November 1984):
  - Dioxin and solvent wastes within 24 months.
  - Wastes on the "California list" (metals, cyanides, corrosives, and halogenated organics) within 32 months.
  - All listed and characteristic wastes within 66 months.
- EPA may delay a prohibition date for up to two years if, on a national scale, alternative capacity is unavailable.
- If EPA fails to make a determination within the allotted time, land disposal of such waste is prohibited (hammer provision).

In order to accomplish what is required under these provisions, EPA has committed substantial resources to determine what wastes are being disposed of to the land, what existing alternative (to land disposal) treatment technologies are currently or could be used for these wastes, and if there exists sufficient alternative capcity to accommodate the wastes that are currently disposed of to the land. The Office of Solid Waste (OSW) has the responsibility to implement the provisions of the RCRA amendments. The Office of Research and Development

(ORD) is providing support to OSW through identification, evaluation, and development of alternative technologies for treatment of hazardous wastes. This discussion will focus on activities that ORD is conducting in the area of existing alternative treatment research.

DEFINITIONS

In order to comprehend the program being discussed, it is important to understand the terms that are used within the EPA program to describe the technologies and activities. The terms that are used most often to describe treatment technologies and that very often lead to confusion are "alternative," "existing," "emerging," and "innovative."

Alternative treatment technologies are non-land disposal treatment technologies. These technologies are, therefore, alternatives to land disposal. Incineration is an example of an alternative technology. Other examples include steam stripping, critical fluids extraction, and biological treatment.

Existing treatment technologies are alternative waste treatment processes that are operating on a commercial basis. For the examples above, incineration and steam stripping are existing technologies because they are commercially available and are being used to treat a number of waste streams.

Emerging technologies are waste treatment processes that are not yet available on a commercial basis. Emerging technologies may be at the demonstration level, may be under development, or may even be merely at a conceptual stage. From the examples above, critical fluids extraction may be classified as an emerging technology.

Innovative technologies are novel application of treatment processes or adaptations of processes designed for other purposes to hazardous waste treatment.

Emerging technologies are most likely always innovative. Existing technologies may be innovative if they are applied to new waste types. For example, adapting a steam stripper that has been used to treat a given solvent to the treatment of a new mixed waste would be considered an innovative application for an existing treatment process. Incineration of contaminated soils would be an innovative application of an existing treatment process.

Treatment research that is conducted in support of the EPA deliberations with respect to the landfill ban provisions is the study of existing treatment technologies. This must be the case since the "hammer provisions," particularly for the early targeted waste streams, have such short time frames that commercialization of emerging technologies would most likely occur too late to have an impact on the ban decision. Consideration of time required for commercialization of emerging technologies may be a factor in the decision to extend a ban "hammer" date but that determination would be contingent upon the decision that adequate existing technology does not exist.

ASSUMPTIONS

EPA's approach to research in support of the landfill ban provisions is predicated on two basic assumptions.

1. There is at least one existing treatment technology that can adequately treat each of the targeted waste streams. The treatment technologies may not necessarily be less costly than land disposal, or even particulary cost effective at all. However, the research is being conducted under the assumption that there is at least one appropriate approach, from a technical perspective, that can manage each waste stream.

2. Treatment goals, at least from a technical, if not regulatory perspective, for wastes to be acceptably disposed of to the land are:
   a. The quality or characteristics of incinerator residues (ash) for organic materials.
   b. The quality or characteristics of stabilized (or "fixed") wastes for inorganic materials.

Therefore, the research approach is the identification, evaluation, and/or demonstration of treatment processes that will make waste either:

- incinerable, or
- fixable, or
- equivalent quality to incinerated or stabilized wastes.

RESEARCH OBJECTIVES

In order to meet the needs of the landfill ban determination process and conforming to the definitions and assumptions described earlier, the objectives of the research program into hazardous waste treatment alternatives are:

- To provide performance evaluations on a sufficient number of alternative hazardous waste treatment systems to allow the OSW to direct that these systems be used instead of or as pretreatments for land disposal for selected hazardous waste streams. These evaluations combined with existing industrial and hazardous waste treatment knowledge will form the basis for hazardous waste treatment standards to be promulgated under RCRA.
- To identify and document situations in industry in which changes in process or waste management technologies has led to improved waste management practices.

- To compile and disseminate technical resource documents and other information to encourage the adoption of environmentally preferable technologies.
- To assure the demonstration of promising alternative hazardous waste treatment technologies so that these technologies may be recommended to and utilized by regulatory and industrial organizations.

RESEARCH STRATEGY

The major research objectives noted in the preceding section will be addressed by projects in four major areas:

1. Technology Assessments
2. Case Studies
3. Technical Resource Documents
4. Demonstration/Evaluation Projects

Each major area will be addressed in detail.

TECHNOLOGY ASSESSMENTS

The program to accomplish this objective consists of initiating a series of in-house and extramural projects to assess the state of information on the use of various processes to treat banned waste streams and to structure pilot-scale or field tests to fill data gaps. This program will initially concentrate on a list of waste types and technologies developed by EPA. The waste types to be studied include aqueous wastes and the six wastes identified for priority action in the land disposal ban legislation: dioxin bearing wastes, solvents, cyanides, metals, corrosives, and halogenated organics. Treatment processes and combinations of processes to be evaluated will include: physical component separation (e.g., adsorption, membrane processes, distillation), phase separation

(e.g., filtration, dewatering), neutralization, chemical oxidation/destruction, incineration, and biological treatment. Following evaluation of the first set of technologies and wastes, additional projects will be undertaken until the complete list of hazardous waste is addressed. This program builds on a foundation of several existing R&D programs that have been initiated in prior years. The specific project areas in this approach are:

1. Criteria for Pre-incineration Waste Treatment

As stated previously, an assumed technical criteria for determining what materials can be disposed of to the land will most likely be to require that the material exhibit the characteristics of incinerator ash in terms of organic content and leachability. Implicitly, therefore, incineration or pretreatment to an incinerable end point will be the treatment methods of choice for many types of waste. This project will consist of an engineering evaluation to establish criteria for which waste streams can be incinerated within the bounds of current practice, environmental and engineering feasibility, and reasonable cost.

2. Existing Incineration Capacity

Since incineration is a treatment process that may be particularly appropriate for solvents and dioxins, a significant consideration in the banning decision for these materials will be incineration capacity. This project will consist of an assessment of actual operating onsite and commercial incineration capacity in the U.S. Capacities will be determined on a waste type specific basis.

3. Incineration Residuals

This program will consist of a sampling and analysis campaign to characterize all solid and liquid residuals from hazardous waste incineration processes.

This data will be used as a baseline for gauging the environmental impact of alternative treatment technologies. Initial targets will be the incineration facilities previously tested as part of EPA's regulatory impact analysis program for incinerators.

4. Criteria for Waste Fixability

Chemical stabilization is a process that holds potential for minimizing discharges from land disposal operations. This project will determine what waste types are amenable to processing through fixation, including pretreatment requirements for waste input.

5. Performance Evaluations of Alternative Hazardous Waste Treatment Systems

This project area will consist of bench-scale, pilot-scale, and field performance evaluations of the alternative treatment systems suitable for managing wastes which are banned from landfills. Data from the evaluations will help to establish pretreatment standards and to assess current treatment capacity. Existing EPA pilot treatment systems, some of which are mobile, will be tested on hazardous waste streams for which inadequate performance data exist. Field studies will be conducted at existing industrial facilities where appropriate pilot systems may be assembled and tested on actual waste streams.

For circumstances where a full-scale treatment process is treating a targeted waste, the performance evaluation will be conducted on the full-scale equipment. For instances where a particular technology is not currently being applied to a targeted waste but which has considerable potential, the waste must be brought to the machine or the machine to the waste. The mobile pilot units can be brought to the site of waste generation or treatment and made to operate on a

"slipstream" of waste. Alternatively, waste may be brought to EPA's inhouse research plant facilities for either bench or pilot-scale testing. In some cases, equipment may be provided by manufacturers for the test program.

CASE STUDIES

Actual performance information is needed to encourage the adoption of improved practices to minimize hazardous waste generation and maximize the recycle and reuse of materials classifiable as wastes. The approach is to work cooperatively through relevant industrial and professional associations to gather and document information about successful treatment activities in industry.

Specifically, this activity will document current industry practice and success stories at a number of existing waste treatment and/or reuse facilities through site visits to collect data on process engineering designs, costs, waste treatability, etc. It is intended to (1) provide documentation of current industry practices and (2) identify operations which may require detailed field assessments.

TECHNICAL RESOURCE DOCUMENTS

High priority being given to disseminating the results of the above activities. The approach is to produce, on a periodic basis, documents, training seminars, or symposia that will summarize the results of ongoing projects and transmit them to the regulated community to aid in their efforts to respond to EPA banning determinations. Technical resource documents are to be prepared for the major categories of waste streams and for the main categories of treatment technologies. In addition, it is planned to continue the annual research symposium sponsored by OR&D for the past 11 years. Specific activities are:

1. Engineering Assessment of Alternative Technologies

This project is to provide a continuing update on the state-of-the-art for alternative treatment technology. Engineering evaluation, incorporating performance assessments from field tests and the results of research and development projects sponsored by the EPA and others, will be carried out. Results of this work will be reported in the technical resource documents, technology transfer reviews, guidance manuals, and technical assistance documents for State and regional regulatory groups. The first activity in this area will be an update and enhancement of a 1976 EPA engineering assessment report on alternative waste treatment technologies and their performance.

2. Technical Resource Documents

Seminars, symposiums, and workshops on case studies, innovative methods and new technologies are to be conducted to disseminate the information produced in the hazardous waste treatment program.

3. Annual Research Symposium

This is an annual EPA-sponsored symposium to present the results of current and recently completed EPA research projects. The symposium is held in Cincinnati.

DEMONSTRATION/EVALUATION PROJECTS

This activity will utilize cooperative agreements with selected State governments and industry to identify and demonstrate processes and approaches that represent clear advantages over land disposal and other existing treatment processes. The demonstration projects will include chemical, physical, and biological systems whose widespread adoption will advance the state of hazardous treatment technology. The projects under this objective are also to be used as

mechanisms for the tests to be included under the first objective of this program. Having States as partners in the program improves the Agency's access to operating facilities that incorporate treatment technologies. Current work involves the States of California and New York.

LEVELS OF EFFORT

In 1985, as it will be throughout this research program, the major activity will be performance evaluations of existing treatment processes. Fully sixty percent of the program resources will be committed to this activity in 1985. The four smaller projects to be conducted in 1985 under Technology Assessment will be completed in less than one year and will absorb only about 13 percent of the program's resources. The balance of the 1985 program will be committed to the Case Studies, Technical Resource Documents, and the Demonstrations.

Research beyond 1985 is a function of the funds made available to EPA for action on its regulatory program. In addition, results from current research will impact future project directions and scopes of work. In this way, promising innovative techniques may be candidates for verification as a proven technology in two to five years.

The rate at which EPA makes waste banning decisions will determine the direction and timing of treatment performance evaluations. In general, however, research for existing technology will continue to concentrate on treatment system performance evaluations of wastes which are under ban consideration at that time. Increased effort will be focused also on preparation of technical resource documents describing completed test work.